IV.—The Collections of William John Burchell, D.C.L., in the Hope Department, Oxford University Museum.

I. Introduction. By EDWARD B. POULTON, D.Sc., M.A., Hon. LL.D. (Princeton), F.R.S., F.L.S., F.Z.S., F.G.S., President of the Entomological Society of London, Hope Professor of Zoology in the University of Oxford, Fellow of Jesus College, Oxford.

[Plate III.]

WHEN, in June 1893, I was first placed in charge of the Hope Collections of the University of Oxford my attention was at once arrested by specimens of insects and other arthropods collected in South Africa about ninety years ago, and much larger numbers from Brazil with dates going back about three-quarters of a century. I was struck by the precision and detail of the data and by the existence of numbers which evidently referred to a diary. Three manuscript note-books were eventually found in the Hope Library, and these showed that the material had been collected by the great naturalist William John Burchell, truly described by Swainson as "one of the most learned and accomplished travellers of any age or country-whether we regard the extent of his acquirements in every branch of physical science or the range of the countries he has explored " (' Cabinet Cyclopædia' of Dionysius Lardner, vol. Taxidermy &c., Appendix, p. 383 : London, 1840).

The first necessity was to ascertain if the data were as accurate as they were full and elaborate. A single quotation from the Brazilian note-book throws much light upon this important question. From Oct. 6th to Nov. 16th, 1825, Burchell was upon an expedition into Minas Geraes from Rio de Janeiro. The following note refers to the beetles collected on four days towards the end of this journey :--

"All the Coleoptera of 3rd, 4th, 5th, and 6th have since been marked 4. 11. 25, as the different day's collections being mixed in one paper could not be distinguished. They were, however, all caught in forests or on the edge of forests. Some other Coleoptera caught on these same days, but which were put up in separate papers and marked, are properly distinguished by their labels, but those *certainly* of the 4th are marked 4. 11. 25, with the 4 underlined, and consist of only a few minute insects caught at night by the candle."

It is obvious that the man who wrote that note was a man

to be trusted, and the immense numbers of his unpublished observations on natural history at once acquire the value of records by a trained naturalist with a fanatical love of truth for its own sake. Here, then, was the means of carrying back the detailed record of the occurrence of many thousands of species in two most interesting parts of the world, and to construct a trustworthy standard by which to measure the rate of future change; for one great justification of the immense funds which are expended on museums is that they will serve this very purpose for generations yet to come. The critical examination of the Burchell specimens proves that with ordinary care and the exclusion of light insects' pigments will endure for probably an indefinite period. Many of these specimens have not had ordinary care during a part of their history, the African collection being especially attacked by Anthreni, probably between 1825 and 1830, when Burchell was travelling in Brazil. But even upon the most fragmentary of these the patterns are still quite distinct and have undergone hardly any change.

The collection, combined with the manuscript notes on labels and in the note-books, furthermore supplies a great body of observations on habits, instincts, &c. which are still imperfectly known, and often altogether unknown. In many cases 1 find the records of interesting observations since made and published by others, such as the sound produced by the South-American butterfly, Ageronia feronia, described by Darwin in the "Voyage of the 'Beagle'" (London, 1876, pp. 33, 34), or the habits of the driver-ant (Eciton) and leafcutting ant (Ecodoma), described by Darwin, Belt, Bates, &c.

When I first began to arrange for the publication of an account of the Burchell Collections at Oxford it was intended to prepare an introductory memoir upon the life of the great naturalist himself; but this proved to be too extensive an undertaking for these pages, and it is hoped that the "Life" will appear as a separate work at no distant date. In the meantime a brief abstract of the chief facts which I have been able to bring together is set forth below as an introduction to the papers which will follow.

William John Burchell, the eldest son of a nurseryman at Fulham, was born about the year 1782. He received an excellent education, as is proved by the admirable style of his published works, the facility with which he wrote Latin, and the number of sciences with which he was intimately acquainted. His manuscript notes on South-African insects in the Hope Department are written on the blank sides of the pages of his French exercise-book—a history of Greece translated into French in 1794, when he was about twelve years old. Burchell was also an accomplished artist and musician. He must have had a remarkable constitution, for he enjoyed uninterrupted good health and vigour throughout his long and, with the exception of native attendants, solitary journeys. He laboured throughout the whole of the time with astonishing energy—collecting, observing, recording, sketching, and writing detailed journals. The details of his tragic end in his eightieth year also show that he possessed extraordinary resolution at that advanced age.

Burchell's features at about thirty-four years of age are preserved in a drawing made by J. S. Cotman in 1816, the year after the South-African travels had come to an end. The drawing was etched by Mrs. Dawson Turner, the grandmother of Sir Joseph Hooker. The portrait, of which there is a copy at Oxford, brings back to us Burchell in the full vigour of manhood. The face is highly intellectual and indicative of strong purpose and resolution, yet singularly attractive, even winning. The appreciation and description in his South-African travels of many a quaint incongruity shows that he possessed an ample fund of humour. His invariable breadth of view and justice are well seen in the calm discussion of the methods and results of missionary labours and his accounts of the shabby treatment he received from some of the Boers, in which he always warns the reader against coming to a too hasty conclusion as to the character of a whole people.

In 1805, when he was about twenty-three, Burchell was appointed "Schoolmaster and acting Botanist" at St. Helena by the East India Company, and he remained in the island for five years, until his departure for Cape Town in order to begin his South-African travels. He was elected a Fellow of the Linnean Society, Feb. 15, 1808. The romance of his life happened in St. Helena, and probably exerted a profound influence upon his character, explaining much that is difficult to understand, and especially the secretive barren period which followed his return from Brazil in 1830. His father had disapproved of Burchell's engagement to a lady in Fulham. and had, perhaps, obtained the appointment in St. Helena, hoping that everything might be forgotten. But the two still corresponded, and Burchell persuaded the lady to come out and join him in the island. During the voyage someone on the ship-it is said, the captain-fell in love with her and married her. Burchell had always been a naturalist and collector, but it is probable that the terrible shock drove him into these pursuits and away from companionship with his fellow-men, for consolation or, at any rate, oblivion. Natural history pursued in this spirit, especially when habits become fixed and deepened with advancing age, is only too likely to lead to the non-productive life of the recluse, poring for long years over his collections, jealously guarding them from the sight of others, and yet giving no account of them to the world.

We now enter on the next great period of his life, the five years (1810-1815) of splendid work in South Africa. The first part of his travels, discoveries, and observations are described in the classical 'Southern Africa' (vol. i. London, 1822, vol. ii. 1824), covering the period between his landing at Cape Town on Nov. 26, 1810, and his departure from Litakun on Aug. 3, 1812. The work contains a large and excellent map, showing the whole of his route. He had intended to follow up these volumes by a complete account of the whole journey, but this was never accomplished, and the manuscript of his journal and other materials from which it might be written have not yet been found. The fine collection of insects which he made in St. Helena and South Africa was almost destroyed by neglect, probably during his absence in Brazil (1825-30), but hundreds of species can be named from the fragments preserved in the Oxford Museum. The botanical collections, now at Kew, did not suffer in the same way, and are in excellent condition.

Burchell remained in England during the ten years which intervened between his South-African and Brazilian journeys. He sowed in his garden at Fulham hundreds of South-African seeds and some from St. Helena, keeping a careful record, now preserved at Kew, of the dates at which they came up. On Sept. 30th, 1817, he presented forty-three skins of South-African quadrupeds to the British Museum, and the neglect of these specimens, many of them unique, was the cause of his quarrel with that Institution (' Southern Africa,' vol. i. p. 383 &c., vol. ii. p. 336 &c.).

A letter to Sir William Hooker, dated March 31, 1819, shows the care he took to suggest appropriate names for the new species which he had discovered :—" I should mention that it was my practice when on my travels to give such specific names to my plants as the view of them in their native place of growth naturally suggested, without attending to their being new or not, which I had not always on the spot time to ascertain; but my object in thus naming them was that on my return to England I should find all the new species with more appropriate names than an inspection of the dried specimens in the herbarium might probably suggest to me." An examination of his Brazilian note-book proves that he adopted the same excellent method in his later travels.

In 1819 Burchell was called to give evidence before a Committee of the House of Commons on the question of emigration as a relief from pauperism. In his evidence, which occupied nearly three hours, he advocated the suitability of the Albany district in the easternmost part of Cape Colony. In a few days the Committee reported, and a grant of £50,000 was voted for this purpose. Burchell then amplified and published his evidence in a pamphlet, 'Hints on Emigration to the Cape of Good Hope ' (London, Aug. 1819). This was savagely attacked in the 'Quarterly Review' for the following November, and Burchell replied in a sheet of four pages bound into the first volume of his 'Southern Africa.' Looking at the controversy from the standpoint of the present day, there can be no doubt that Burchell was entirely right and that the loyalty of the Grahamstown district, which has shone so conspicuously during recent years, is in large part the outcome of his wise advice.

More than all the work described above, the arrangement of his South-African collections and the preparation of the two volumes on South Africa occupied Burchell's time until he began to get ready for his next great journey.

Of the five years in Brazil very little is known, mainly because Burchell published nothing after his return. Hooker's 'Botanical Miscellany' (vol. ii. 1831, pp. 128–133) contains some very interesting extracts from his letters to Sir William Hooker, and the life of Burchell in the 'Dictionary of National Biography' (vol. vii. London, 1886, p. 290) also has an excellent short account of these travels.

Inasmuch as the Brazilian collections of insects &c. are far more extensive than the African, and are, considering their age and the vicissitudes through which they have passed, in excellent condition, the following papers will be chiefly concerned with them, and it becomes of the utmost importance to show the exact route traversed by Burchell. This is clearly shown by the map on the accompanying Plate III., prepared from the data obtained by Miss Cora B. Sanders, of Lady Margaret Hall, Oxford. The data were gained by a careful study of Burchell's manuscript note-books at Oxford, and especially the Index to the Localities of the Plants and Insects. Miss Sanders was able to find many of the names which have disappeared from modern atlases by an examination of the older maps of Brazil in the possession of the Royal Geographical Society. The numerous smaller villages, halting-places, streams, &c. mentioned in the manuscript Ann. & Mag. N. Hist. Ser. 7. Vol. xiii. 4

49

note-books or upon the specimens themselves will always be described as between or near places which have been thus identified and are indicated upon the map. As regards Burchell's two expeditions from Rio de Janeiro into Minas Geraës and the Organ Mountains, hardly any of the places mentioned could be found; but it is clear from the time occupied and the account of the work done that he did not travel far.

Following the exact data which Burchell always records, we find that he left Fulham at 9.30 A.M. on March 10, 1825, and sailed from Portsmouth at 9 A.M. on March 15th. The main outlines of the journey are set forth below in a tabular form copied from a paper gummed into one of his manuscript note-books in the Hope Department, viz. "Index to the Localities of the Plants in the Brazilian Herbarium &c., serving also for the Localities for the Collection of Insects &c." The only modification of Burchell's original table is the insertion of the two expeditions from Rio in their proper positions in time, instead of placing them at the end, and thus putting the three separated periods in Rio itself in juxtaposition.

| PLACE. | Dates. | Тіме. | |
|--|---|-----------------------------------|-------|
| | | Months. | Days. |
| Voyage | | | 11 |
| In Portugal | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 2 | 0 |
| Voyage | | | 5 |
| Madeira | 29, 5, 25 | | 1 |
| Voyage | | | 2 |
| Teneriffe | 1. 6. 25 | • • • • | 2 |
| Voyage | · · · · · | 1 | 16 |
| Rio de Janeiro Minas Geraës Rio de Janeiro | $ \left\{ \begin{array}{c} 18. & 7. 25 \\ 6. 10. 25 \\ 6. 10. 25 \\ 16. 11. 25 \\ 16. 11. 25 \\ 5. 2. 26 \\ \end{array} \right. $ | 1 | 4* |
| Organ Mountains | $\left\{\begin{array}{ccc} 6, & 2, 26 \\ 2, & 3, 26 \end{array}\right\}$ | | 27 |
| Rio de Janeiro | $\left\{\begin{array}{rrr} 2. & 3. 26 \\ 10. & 9. 26 \end{array}\right\}$ | [total time spent in Rio] } 11 | 16 |

* This number is given by Burchell. He probably deducted the days spent in travelling from and to Rio.

of William John Burchell.

| Place. | Dates. | Time. | |
|--------------------------|--|---------|-------|
| | | Months. | DAYS. |
| Voyage from Rio | | | 3 |
| Santos | $ \begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 2 | 21 |
| Cubatão | $ \left\{ \begin{array}{c} 3. \ 12. \ 26 \\ 17. \ 1. \ 27 \end{array} \right\} $ | 1 | 14 |
| Travelling | ••••• | •••• | 3 |
| S. Paulo | $ \left\{ \begin{array}{ccc} 20, & 1, & 27 \\ 24, & 7, & 27 \end{array} \right\} $ | 6 | 4 |
| Travelling | $ \left. \begin{array}{c} 25. & 7. & 27 \\ 2. & 11. & 27 \end{array} \right\} $ | 3 | 8 |
| Goyaz | $\left\{ \begin{array}{ccc} 3.\ 11.\ 27 \\ 21. & 8.\ 28 \end{array} \right\}$ | 9 | 18 |
| Travelling | $\begin{array}{c ccccccccccccccccccccccccccccccccccc$ | 2 | 22 |
| Porto Real | $\left\{ \begin{array}{ccc} 14.\ 11.\ 28 \\ 27.\ 4.\ 29 \end{array} \right\}$ | 5 | 13 |
| Travelling (Tucantins) . | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | 1 | 13 |
| Pará | $ \begin{array}{cccccccccccccccccccccccccccccccccccc$ | 8 | 0 |
| Voyage | | 1 | 15 |

Burchell landed at Dover on March 24th, 1830, and reached his home in Fulham on the following day.

The journey originally planned by Burchell was far more extensive. Thus he wrote to Sir William Hooker from Rio (July 8th, 1826) :---

"... It is at least my wish to visit the city of S. Paulo, and thence by land through the provinces of Goyaz, Cuyaba, and Matto Grosso into Peru, having the city of Luzco as my principal object; and after doing in Peru as much as my time (for my family prefer my being in Eugland) and slender means will allow me to do, I should wish to proceed by land to Arequipa, Potosí, Salta, &c., &c., to Buenos Ayres, and thence to my home at Fulham. ..."

A letter nearly two years later to the same friend explains the change. It is dated from Goyaz, April 25, 1828 :---

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"... I have kept my original plan always in view, and had advanced thus far on my way to Peru &c. when letters from Fulham overtook me, stating that my dear father's health, from the infirmities natural to his age, was gradually declining, and that it was his wish and that of the rest of the family that I should return directly to England. Whatever regret I may feel at thus relinquishing my American travels, and whatever disappointment I may experience from a premature return, I have no hesitation whatever in preferring filial duty to science and the gratification of my own inclinations. I have therefore greatly altered my plans, and instead of ending this journey at Beunos Ayres, shall, *Deo volente*, end it at Pará, where I shall embark for England."

Burchell was not destined to see his father again, for Matthew Burchell died soon after this letter was written, on July 12, 1828.

An excellent brief account of the Brazilian journey is given in a letter to Sir William Hooker, written from Burchell's home at Churchfield House, Fulham. Much of it is printed in 'Hooker's Botanical Miscellany' (vol. ii. 1831, pp. 128– 133). The original letter, together with the others which have been made use of on the present occasion, are preserved in the Herbarium of the Royal Gardens at Kew. The letter is dated Nov. 1, 1830:—

"I left England in March 1825, passed two months at Lisbon and in the vicinity : landed at Rio de Janeiro in July, where I continued making collections in botany, entomology, and geology, &c., till Sept. 1826, during which period I visited a part of Minas Geraës. While at Rio I made some drawings of landscape, among which was a panorama taken from a hill in the middle of the city; many astronomical, philosophical, and geodetical observations. I finally quitted Rio in Sept. 1826, and proceeded by sea to Santos, where I remained three months, and then proceeded and took up my station in a solitary hut in the midst of forests at the foot of the great range of mountains, for the purpose of exploring them at leisure. My next station or headquarters was at the city of S. Paulo, nearly under the tropic of Capricorn, where I remained about seven months, extending my excursions in various directions. Having there purchased a troop of mules and engaged the requisite muleteers, I travelled northward, and finally took up my station at the city of Goyaz, being the first and only Englishman who has entered that province. There I passed the rainy season of 1827 and made large collections, being detained there nine months, owing chiefly to the difficulty of finding the means of conveyance for my baggage. At length, resuming the road and still continuing Northward, I reached in November 1828 Porto-Real, on the great river Tucantins. Here I remained till the proper season for embarking, and, descending the stream, at all times rendered dangerous by numerous rocky falls, rapids, and whirlpools, I made considerable collections on ground over which no scientific traveller had ever passed. I completed a survey of the whole length of this voyage, fixed by numerous astronomical observations. Finally, I arrived at the city of Pará in June 1829, and, while waiting till February for a convenient opportunity of embarking for England, added largely to my collections both in zoology and botany. Of this city I made a panorama, which, with that of Rio, I hope perhaps to succeed in getting engraved, together with my landscapes &c. Of insects I found from 16 to 20 thousand specimens (at a guess). Of birds I shot and preserved 362 species. In the other classes a proportionally smaller number. I am not aware of any part of my collections being lost, though I daily lament my inability to unpack them for want of room in the house. The space I require is large, and I have some hesitation in building on bishop's land, unless it were possible to enfranchise it. I fear I shall lose much time before I am comfortably settled: nothing is more distressing to me than thus to be forced to delay my labours in arranging my collections and rendering them useful to science. You, who are so great an example of industry, complain also of overwhelming collections, and feel the necessity of manual help. But I have nowhere beheld an herbarium so large as my own; and, added to this, I cannot bring my mind to abandon any branch of natural history for the sake of giving more time and attention to any one in particular; although I know this is wrong and can never lead to perfection in any. Still the contemplation of the whole system of created objects is so fascinating that it is very diffic[ult to] turn away from all but a few.

These latter sentences, together with the considerations mentioned on pages 47, 48, help us to understand Burchell's unproductive later years. Living secluded in the midst of his vast collections, he wandered from one point to another without the stimulus to work out any one part thoroughly which contact with his brother naturalists would have supplied. Furthermore, he belonged to that class of men, much rarer now than formerly, who value and gloat over collections as collections. His letters, even to his most intimate friends, such as Sir William Hooker, as well as many records preserved in his note-books, show that he jealously watched over the material of his collections, and indicate that he suffered much anxiety on this account. His will, which was proved for probate at under £4000, also shows that he was right in the contention that he could not afford to employ assistance in the skilled mechanical work which was required, while his almost tooscrupulous care and attention to detail must have consumed an immense amount of his time. Sir William Hooker had evidently urged him to employ a curator or librarian, for Burchell's letter of June 25th, 1835, contains the following passage :—" After the consumption of so much of my property by my travels and the disinterested pursuit of science all the rest of my life, the obtaining of assistance by payment is quite out of the question." Similar advice had been given and answered in the same sense five years before.

The degree of D.C.L. Honoris Causa was conferred upon Burchell by the University of Oxford on May 8th, 1834. Daubeny, the Professor of Botany, had given his inaugural address on May 1st, and the first lecture of his first course (on Vegetable Physiology) was delivered on May 8th. It seems probable that Burchell came to Oxford in order to be present, and that the occasion was selected for the conferment of the degree.

There is no doubt that Burchell expected a government pension and that he bitterly resented what he regarded as undeserved neglect. Hence, to the other causes which operated to prevent productive work, we must add the brooding melancholy and the bitterness of a disappointed man, the 'man with a grievance.

It is probable that he freely communicated his ideas on this subject to his friend Swainson, and that the attack on the government for neglect of Burchell was a result of their intimacy. These severe criticisms may be seen in Swainson's article quoted on page 45. The same article is probably responsible for exaggerated statements, which have been constantly repeated, as to the condition of his collections and the assertion that they were never unpacked. It was probably an extreme way of indicating the injury which science was receiving because Burchell remained unassisted. But it was certainly exaggerated. In the note-books at Oxford there is the record of the different dates at which he accomplished the setting of the various groups of Brazilian insects. Moreover, the beautifully written labels which nearly all specimens possess are very different from the hasty but distinctly legible notes made in the field. Many specimens still retain both labels, but generally the older ones have been discarded.

To this grievance was added the further sense of failure in

that others were continually gaining credit for work which he had done but had not published. Thus he wrote to Sir William Hooker on Sept. 3, 1832 :--

"I am vexed almost to death at all my fine collections being thus shut up from me while I am daily losing portions of the only reward a traveller has—that of his discoveries. . . . I trust that [in] future my work will make more show, at least to the world."

A few years later the same kind friend seems to have made a great and probably a final effort to induce Burchell to publish his results. Burchell's reply is dated June 25th, 1835 :---

"From the manner in which you express yourself with regard to my botanical collections you appear to be under very erroneous impressions, for to say that I 'will not publish' is quite the opposite to what has ever been my intention, and the almost only pleasure I had in my travels to alleviate the excessive toil of forming them was the anticipating of the gratification of publishing them at my return to Europe, and of obtaining the satisfaction of being useful to science, and of securing the honor [spelt thus, according to his custom] due to my discoveries; and if I have been, and still am being, robbed of those honors by others, who, having less on their hands than I have, can run the publishing race with more expedition, I feel most sensibly the injury I sustain. Many circumstances have unfortunately concurred hitherto to tie up my hands, but I do and shall ever look to Natural History as a most delightful and congenial employment for my future vears."

Probably owing to the combination of causes set forth above and their deepening effect as years went on, Burchell became more and more of a recluse, and kept his collections more and more from the sight of other naturalists. The climax was reached when he refused the request of his old friend to allow his son, Sir Joseph Hooker, to see the collection of St. Helena plants, in order to help in the production of a work upon the flora of that island.

Towards the end of his life Burchell must have come to realize that his methods could lead to nothing. He committed suicide on March 23rd, 1863, in his eightieth year. It is stated by C. J. Fèret, in 'Fulham Old and New' (London, 1900), that he "shot himself under the large cedar tree in front of Churchfield House. The wound not proving fatal, he terminated his existence by hanging himself in a small out-house at the back."

Burchell's collections were not specially mentioned in his

will (dated March 2, 1841). Upon his death in 1863 they came into the possession of his sister, Miss Anna Burchell, who offered the whole of them to the University of Oxford in the following year upon the condition "that separate rooms shall be set apart for them, and that the whole be put out, set up, and systematically arranged, and be called 'The Burchell Collection' or presented to the Museum by Wm. J. Burchell, Esq., D.C.L." The Delegates of the Museum were unable to accept these conditions. A few months later Miss Burchell wrote (April 8, 1865) concerning "the collec-tions in Zoology and Entomology," "I am still desirous, in accordance with what I believe to have been his [Dr. Burchell's] wish, of presenting the same to the University of Oxford." The only condition was "that the Collections should be distinguished as those of my late Brother." This offer was gratefully accepted, and in a few weeks the collections arrived. About the same time the immense Herbarium was offered by Miss Burchell to the Linnean Society, which was unable to accept it. A little later it was presented to the National Collection at Kew.

In drawing up this brief account of Burchell, as a preface to the description of his collections, I desire above all to acknowledge the kind help I have received from Miss Cora B. Sanders in the study of Burchell's manuscript at Kew and Oxford, and of his collections in the Hope Department. It has been already mentioned that the map forming Plate III. is entirely due to Miss Sanders's researches. I have also received the kindest assistance and encouragement from Sir Joseph Hooker and also the authorities of the Royal Gardens at Kew. The Delegates of the Oxford University Museum have kindly given me access to their correspondence and minute-books.

II. On a new Stridulating-organ in Scorpions discovered by W. J. Burchell in Brazil in 1828. By R. I. POCOCK, F.Z.S.

[Plate IV.]

UP to the present time stridulating-organs are known with certainty to exist in three genera of scorpions, namely, the Oriental genus *Palamnœus*, the tropical African and Arabian genus *Pandinus*, and the South-African *Opisthophthalmus*, all belonging to the family Pandinidæ. The certainty in these cases lies in the fact that in both *Palamnœus* and *Opisthophthalmus* the hearing of the sound preceded the anatomical investigation which led to the discovery of the organ, and that in the species of *Pandinus* an organ exists exactly similar in structure to that of Palamnæus, although the rasp and the vibratile bristles occur upon different segments of the chelæ and legs of the first pair in the two genera. What is believed to be a stridulating-organ has also been found in certain South-African species of the genus Parabuthus, which belongs to a totally different family, namely, the Buthidæ. Unfortunately in this instance there is no proof, based upon human perception of the sound emitted by the living animal, that the function of the organ described has been correctly interpreted. The tenability of the supposition, however, is justified by the structure of the organ and by the distinctly audible stridulation it can be made to yield, when the appropriate movements, all capable of being performed by the animal itself, are induced by artificial means on a freshly killed or alcohol-preserved specimen.

In the Pandinidæ the stridulating-organs have been developed in connexion with the anterior appendages. In Opisthophthalmus it consists of large foliaceous bristles on the inner (preaxial) surface of the basal segment of the cheliceræ, and the sound given out by the rubbing of these appendages together is in many cases supplemented by the sound produced by the catching of certain short, erect, stiff bristles on the dorsal side of this segment against the anterior edge of the carapace as the appendages are forcibly withdrawn beneath it.

In Pandinus and Palamnœus it lies between the basal segments of the appendages of the third and fourth pairs, commonly called the chelæ and first pair of legs, and consists of a finely papillate area and an area beset with short erect bristles exactly like those that are found upon the upperside of the basal segment of the cheliceræ in Opisthophthalmus*.

In Parabuthus what is supposed to be a stridulating-organ is totally different both in structure and position. It is a finely granular or transversely ridged area upon the dorsal side of the first and second segments of the tail, possibly also upon that of the last tergal plate of the abdomen, and the stridulation above mentioned can be artificially produced by scraping the point of the sting over the roughened field in question †. A fairly similar but less differentiated system of granules, probably subserving the same end, is found upon the first segment of the tail in certain black North-African species of Buthus, namely, the Egyptian B. bicolor and the Algerian B. aneas ‡.

- * See Pocock, Nat. Science, ix. pp. 17-25 (1896).
 † Pocock, Proc. Zool. Soc., March 1902, pp. 222-224.
- ‡ Pocock, Ann. & Mag. Nat. Hist. (7) x. p. 374 (1902).

Apart from the legs, which are almost immovably welded by their basal segments to the sternal surface of the body, the cheliceræ, chelæ, and tail are, with one exception, the only organs in a scorpion susceptible of vigorous and rapid movement. The one exception is the pectines. It is in connexion with these appendages that the stridulating-organ now to be described has been discovered *.

In the course of a recent study of Burchell's manuscript 'Note-book of Brazilian Insects &c.,' Professor Poulton found the following record under the date December 3rd, 1828 :---

"1274. Scorpio of a light redish [thus] brown. Legs and claws pale. Several of these were caught in my house. I found one feeding on a large blatta which it held close to its mouth with its claws. 'Lacráia.' Makes a noise between a hiss and a whistle, v. J. 31. 12. 28, with its pectiniform appendages."

The word "Lacráia" evidently represents the native name of the species. Burchell always made a point of obtaining such names whenever possible, and took the greatest pains in writing them clearly and inserting accents. The reference "v. J. 31. 12. 28" apparently alludes to a Brazilian journal which has unfortunately not been found. It certainly did not reach either Oxford or Kew.

At once appreciating the interest and importance of the last sentence of the note, Prof. Poulton arranged for the collection to be searched for a scorpion bearing the number 1274. The specimen was soon found by Mr. W. Holland, and Prof. Poulton brought it to the Natural History Museum and asked me to determine it and to examine the pectines, to discover if possible the nature and situation of the stridulatingorgan. This I undertook with the greatest pleasure, and with the result that the accuracy of Burchell's observation was substantiated to the full.

The specimen is a male and belongs to the Brazilian species that I described last year as *Rhopaturus Borellii*. Although dried, it is sufficiently well preserved to preclude all likelihood of error on this point; but without the relaxation or removal of the pectines the structure of the stridulating-organ could not be investigated. The examination necessary for this

* Reference may here be made to the suggestion of Landois ('Tierrstimmen,' pp. 22-23, 1874), that the pectines might be capable of emitting sounds by friction. This idea, however, was not supported by facts, and, except that the guess has now been verified, it is on a par with Wood-Mason's view that the prehensile teeth on the digits of the chelæ in Buthidæ might also be used for this purpose (Proc. Ent. Soc. London, 1877, p. xix). purpose therefore was carried out upon the three spiritpreserved examples the Museum possesses, namely, the type, an adult female, an immature specimen of the same sex, and an adult but badly preserved male.

Although only described seven months ago, this species has been known to me for ten years. Briefly told, its history and that of its allies is as follows :- In 1893 * I pointed out that two American species of Buthidæ identified with the Scorpio junceus of Herbst and Tityus agamemnon of C. Koch differ from their allies in the structure of the pectines and of the first sternal plate of the abdomen. The pectines are unusually broad in their proximal half, and the overlying area of the sternal plate is depressed, the grooves which ordinarily pass forwards and inwards from the inner extremity of the stigma being exceptionally deep and lying nearer to the middle line, so that they define a narrow, smooth, triangular area, standing at a higher level than the depressed lateral portion already mentioned. On the strength of these structural features the genus *Heteroctenus* was established for these two species. It was also stated that Heteroctenus junceus differs from the form then referred to H. agamemnon in having the depressed area smooth instead of closely and finely but distinctly granular. Subsequently, as a result of the publication of Dr. Kraepelin's monograph + on the scorpions, it was found that these two species can scarcely be separated generically from the species described as *Rhopalurus* laticauda by Thorell and R. princeps by Karsch. Furthermore, the description given by Kraepelin, presumably from an examination of the type of Tityus agamemnon, proved my previous determination of agamemnon to be erroneous. therefore redescribed the species so determined under the new name Borelliit, and at the same time attempted to show that the five species under discussion-namely, junceus, laticauda, princeps, agamemnon, and Borellii-possess certain characters in common of sufficient systematic value to justify their separation from the series forming the genus Centruroides, with which Kraepelin associated them, and to demand their recognition as a distinct genus for which the name *Rhopalurus* is available §.

The significance of the depressed sternal areas and of the expanded pectines in *R. Borellii* and *R. junceus* was always

- † Das Tierr., Scorpiones et Pedipalpi. pp. 94-95 (1899).
- ‡ Ann. & Mag. Nat. Hist. (7) x. p. 375 (1902).
- § Biol. Centr.-Amer., Arachn. Scorp. p. 37 (1902).

^{*} Journ. Linn. Soc., Zool. xxiv. p. 393.

a puzzle, and would probably have remained unsolved, so far at least as I was concerned, had it not been for Burchell's until now unpublished discovery of three-quarters of a century ago. Probably the absence of the granules on the depressed sternal area in R. junceus, suggesting as it did the secondary importance of their association with the sternal depressions and with the pectinal expansions in R. Borellii, coupled with the flexibility, comparative softness, and known sexual physiological significance of the pectines in these and all other scorpions, combined to conceal the true construction, which, thanks to Burchell's observation, is now known to be assignable to the features in question.

How, then, is the sound described by Burchell as "between a hiss and a whistle" produced? Without doubt by sweeping the pectines across the granular field on the overlying sternal plate (Pl. IV, fig. 2). When one of these organs is turned over it may be noticed that the teeth opposable to the granular area are not parallel-sided, as is normally the case in scorpions; the distal edge is sinuous, presenting towards the apex of the tooth a very decided bulge, which shows up as a slightly thickened area as it catches and reflects the light. When examined under a half-inch objective, or even a lower power, practically the entire face of the tooth, and especially the bulging area, is seen to be covered with a multitude of fine striæ lying parallel to the longitudinal axis of the tooth (Pl. IV. fig. 3). That the structural modifications of the teeth above described are directly connected with the depression and granulation of the sternum is shown by the absence of such modifications in the teeth at the distal end of the series which lie beyond the granular area and sweep clear of it with the movement of the pecten. No doubt the expansion of the shaft of the pecten in its proximal half is correlated with an increase in the size of its muscles and of the surfaces to which they are attached to add force to the sweep of the organ.

Except for the apparent absence of the granules, the sternal depressions in R. junceus closely resemble those of R. Borellii. I originally described these depressions as smooth; this is only true relatively speaking. No granulation is visible under a lens of low power, and no roughness is perceptible with a pin-point; but when scrutinized with a half-inch objective the entire surface of the depression is seen to be exceedingly minutely shagreened, so minutely as to suggest that the sound emitted must be much finer than that which the organ in R. Borellii gives out. Nor is this all the

difference between the two species. The pectines in R. junceus are expanded exactly as in R. Borellii, and the distal edges of the teeth bulge in almost precisely the same way, but the differentiation of the striæ is carried to a greater extreme. Along the edge of each tooth there is a distinct series of small tubercular elevations, which are largest where they cross the thickened bulging area, becoming smaller both above and below it. These elevations are very distinctly striated, and the striæ appear to be practically restricted to them (Pl. IV. fig. 4).

In R. laticauda, Thor., the granules on the sternite are relatively as coarse as in R. Borellii, but the area is less depressed and less sharply differentiated both in front and towards the middle line than in that species. Also the posterior surfaces of the pectinal teeth are less visibly striated and the distal edges of those opposable to the granular area are straight and without the characteristic bulge so noticeable in R. Borellii and R. junceus. In all these features the organ in R. laticauda is less specialized than in the two species just mentioned.

The remaining species of Rhopalurus are unknown to me. Those who have had the opportunity of seeing and describing R. princeps have made no mention of any structural peculiarities in the pectines or in the first abdominal sternum. According to Kraepelin, who has seen the typical examples, however, this species is nearly related to R. laticauda. Hence it is permissible to suppose that it also possesses a stridulating-organ similar in its general features to the stridulator of that species. In the case of R. agamemnon the lastmentioned author states that the pectines are expanded and the sternum grooved and depressed as in R. junceus, but that the sternum differs from that of R. junceus in being distinctly granular on the median triangular area. This peculiarity, in which R. agamemnon holds a unique position in the genus, suggests that the median area in question constitutes an integral part of the stridulating organ. Whether the depressed areas are granular or shagreened, or neither, is at present unknown.

Two other important facts connected with Burchell's observation remain to be mentioned. The first is the discovery of stridulating-scorpions in America: those in which soundingorgans are known or supposed to exist have hitherto been recorded from the Mediterranean, Oriental, and Ethiopian regions. The second is the announcement of the exact locality of *R. Borellii. R. princeps* occurs in Hayti, *R. junceus* in Cuba *, R. laticauda in Venezuela and Colombia, whereas the only examples of R. agamemnon and R. Borellii hitherto known are labelled "Brazil," without further particulars. Thanks, however, to Burchell, we are now aware that R. Borellii is found in the Province of Goyaz, in the upper valley of the Rio Tocantins or that of at least one of its tributaries. Burchell was at Porto Real (now Porto Nacional) when he made his note on specimen no. 1274. Burchell's collection also contains another specimen of the same species (a female) bearing a label "Body and legs Between the boxes at our station at Sape. redish. 15. 10. 28." Referring to the Index we find that Burchell gives "Sa Brigida" as his locality on Oct. 15, 1828. Sapé is mentioned on Oct. 14. The position is between Cavalcanti, his resting-place on Sept. 30th, and Conceição, which he reached on Oct. 18th, but apparently much nearer to the latter. A glance at Plate III. will show the positions of these two localities of R. Borellii.

So far as the function of the organ in these American Buthidæ is concerned, it need only be said that since it is equally well developed in both sexes, and occurs also in immature forms, there is no reason to suppose that it has any sexual significance. Hence, like the stridulating-organs of other scorpions and of the spiders of the family Aviculariidæ, its significance must be regarded as purely aposematic.

EXPLANATION OF PLATE IV.

- Fig. 1. Rhopalurus Borellii, Poc., \mathcal{Q} , nat. size; drawn from typical example.
- Fig. 2. Ditto. Ventral surface of anterior extremity of abdomen and of posterior extremity of cephalothorax, to show the granular areas on the first abdominal sternite, the pecten of the left side being removed.
- Fig. 3. Ditto. Piece of the pecten seen from its dorsal side, to show the finely ridged stridulating area.
- Fig. 4. Rhopalurus junceus (Herbst). Ditto.

V.—Notes on Depastrum cyathiforme, Gosse. By E. S. RUSSELL.

[Plate V.]

M. SARS, in 1846, was the first to describe and figure this interesting little Lucernarian. He discovered it near Bergen and described it under the name of *Lucernaria cyathiformis*

* There are specimens in the British Museum labelled "Mexico" and "Brazil." These localities, however, require confirmation.